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Electricity Market Influences
on Communication & Control Systems for Distributed Energy Resources

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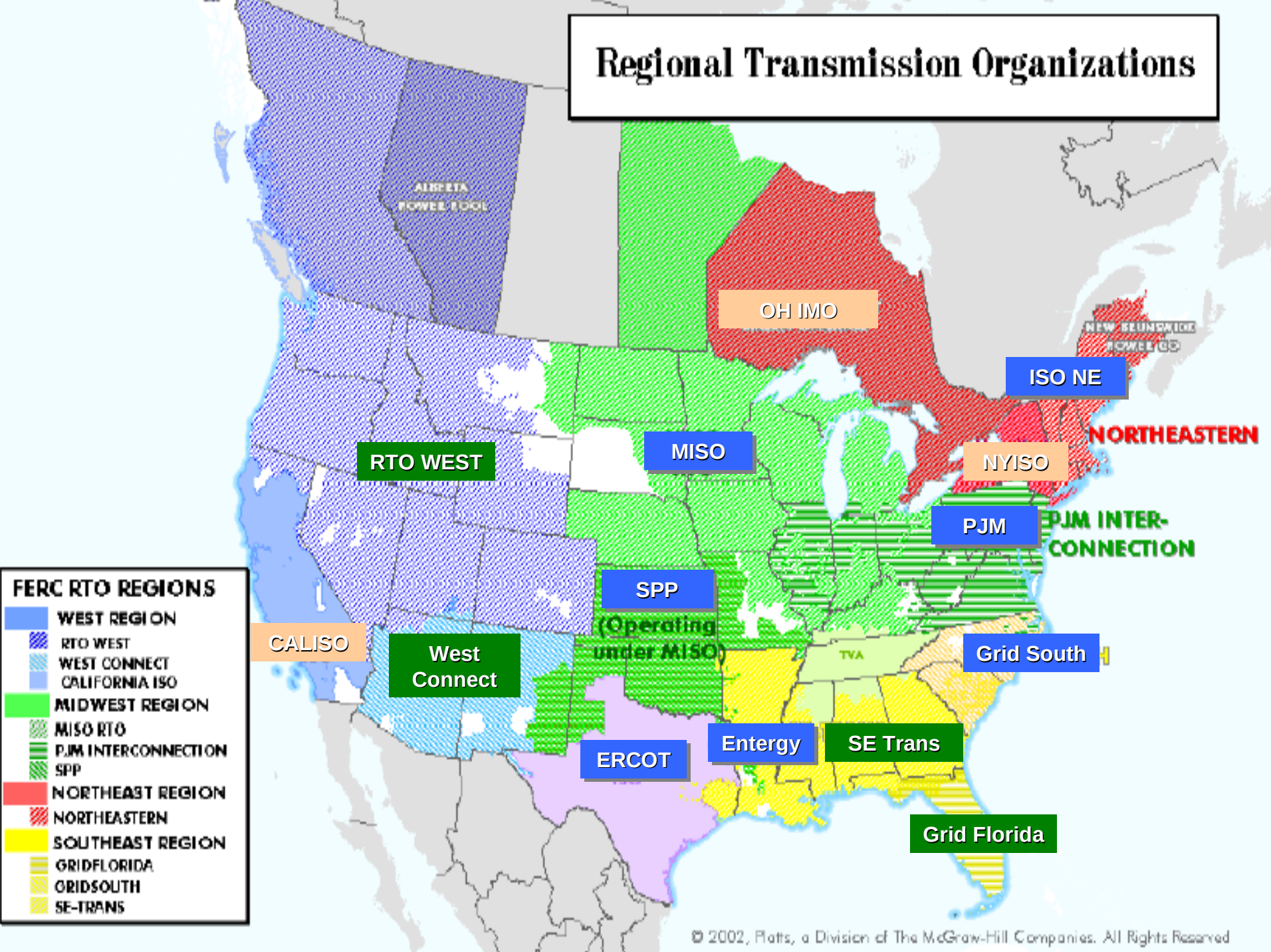
Overview

- Regional Electricity Markets
- Distributed Energy Resources (DER) in an RTO Context
- Implications of Regional Market Rules on Communication and Control Systems for DER
  - FERC NOPR on Standard Market Design (SMD)
  - Demand Response and other Business Opportunities for DER
- Recognizing Full Value of DER
  - Services that DER can supply to the Grid
  - Capturing value of DER through Regional Market Tariffs
- Conclusions


Regional Transmission Organizations
OH IMO
ISO NE
NORTHEASTERN
NYISO
RTO WEST
MISO
PJM
PJM INTER-
CONNECTION
SPP
(Operating
under MISO)
CALISO
West
Connect
TVA
Grid South
ERCOT
Entergy
SE Trans
Grid Florida
FERC RTO REGIONS
WEST REGION
RTO WEST
WEST CONNECT
CALIFORNIA ISO
MIDWEST REGION
MISO RTO
PJM INTERCONNECTION
SPP
NORTHEAST REGION
NORTHEASTERN
SOUTHEAST REGION
GRIDFLORIDA
GRIDSOUTH
SE-TRANS
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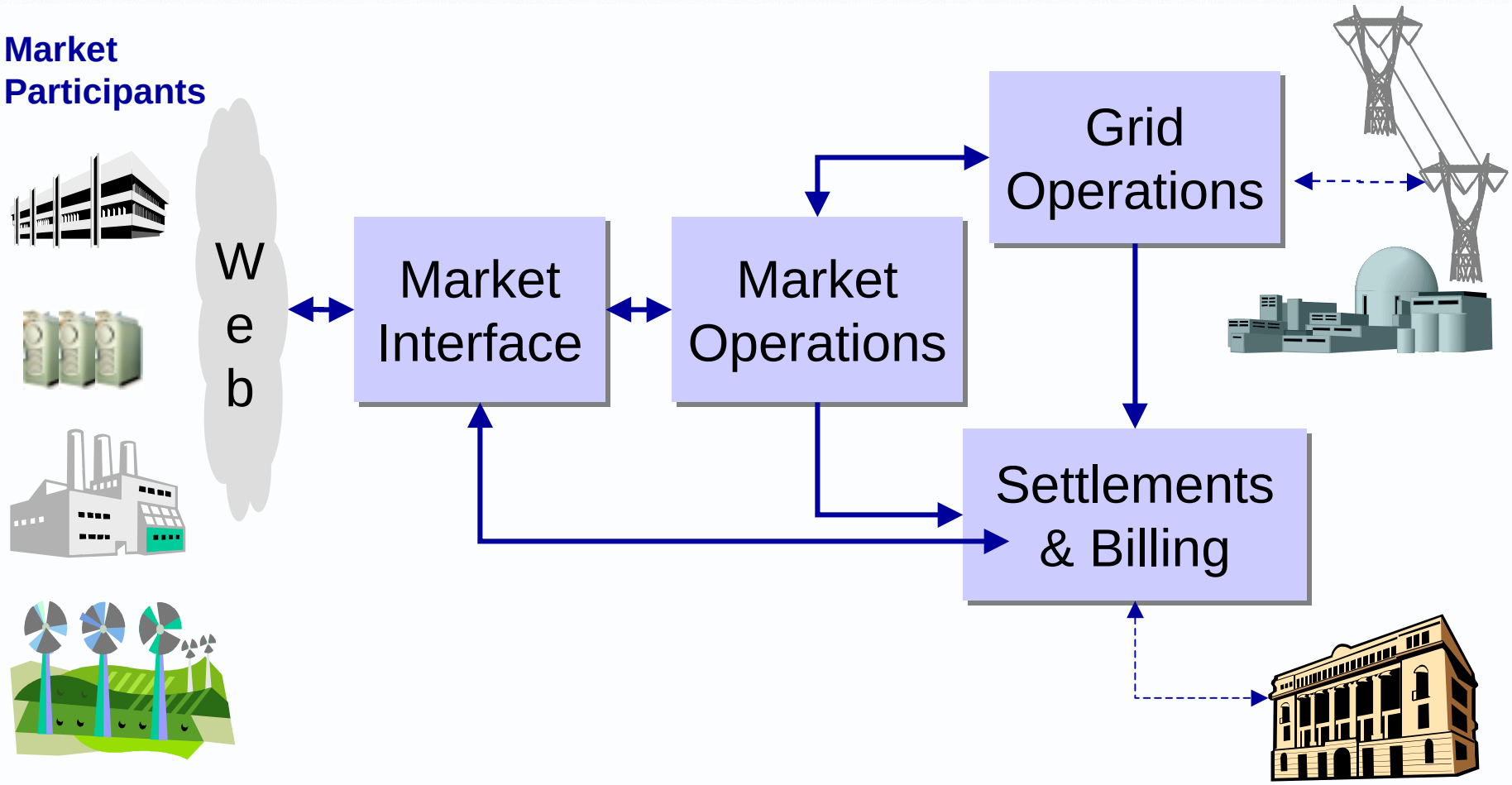
RTO Business Process



Receive Schedules & Bids, Operate Markets & Grid, Settle & Bill

Distributed Energy Resources in an RTO Context

ALSTOM

Distributed Energy Resources (DER):

Resources (such as DG, price responsive load, and pump storage) that can be relied on to provide **Demand Response** or other services of value to the grid.

Demand Response (DR):

A **dynamic change** in electricity production by DG or consumption by Load in response to market & grid conditions.

DER is the Resource that supplies a Valuable Service like Demand Response

FERC SMD - Pertaining to DER

- Encourages investment in DR Infrastructure
- Demand Treated with Equal Footing as Supply
- Demand-side Bidding in Wholesale Markets
- Form of Demand Response
  - Must be verifiable
  - RTO must be able to rely on contribution when called on during shortage
  - E.g.: LM, Demand Bidding, interruptible load, interconnected DG
- Resource Adequacy Requirement
- Alternative Energy Providers on Stakeholder committees
  - DR technologies, DG, and renewable energy providers
- Implementation Plans Filed by Dec 2003

SMD Implications on DER Communication and Control

- DER contribution must be Reliable and Verifiable
- → C&C systems that let RTOs rely on & verify DER contribution
  - Grid operators need real-time visibility to resources
  - Some RTOs already requiring real-time telemetry of DER

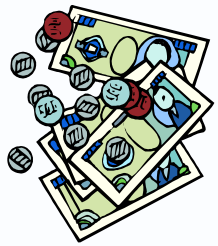
- Demand-side Bidding part of Wholesale Market Design
- → C&C Systems to support Demand-side Business Process
  - Infrastructure & IT systems for market participation by DER
  - Transactional: Bidding, Metering, Billing, and Settlements
  - Operational: DER Monitoring, Verification, Notification/Control
- → Certification requirements

Demand-Side Bidding Process for Market Participant

RTO

Web

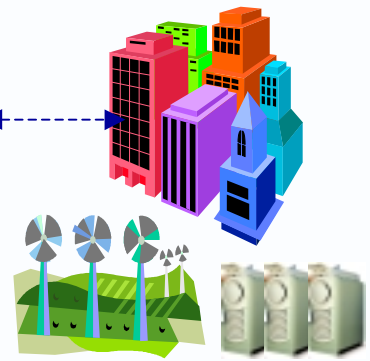
Shadow Settlements

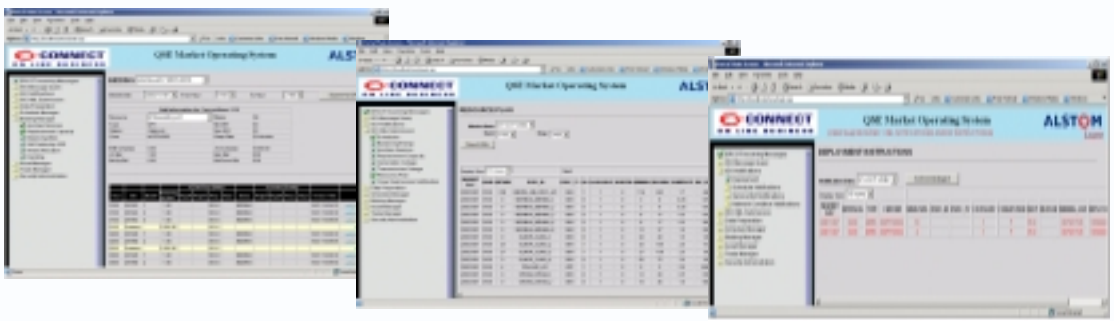


Market Interface

Resource Plan

Resource Deployment





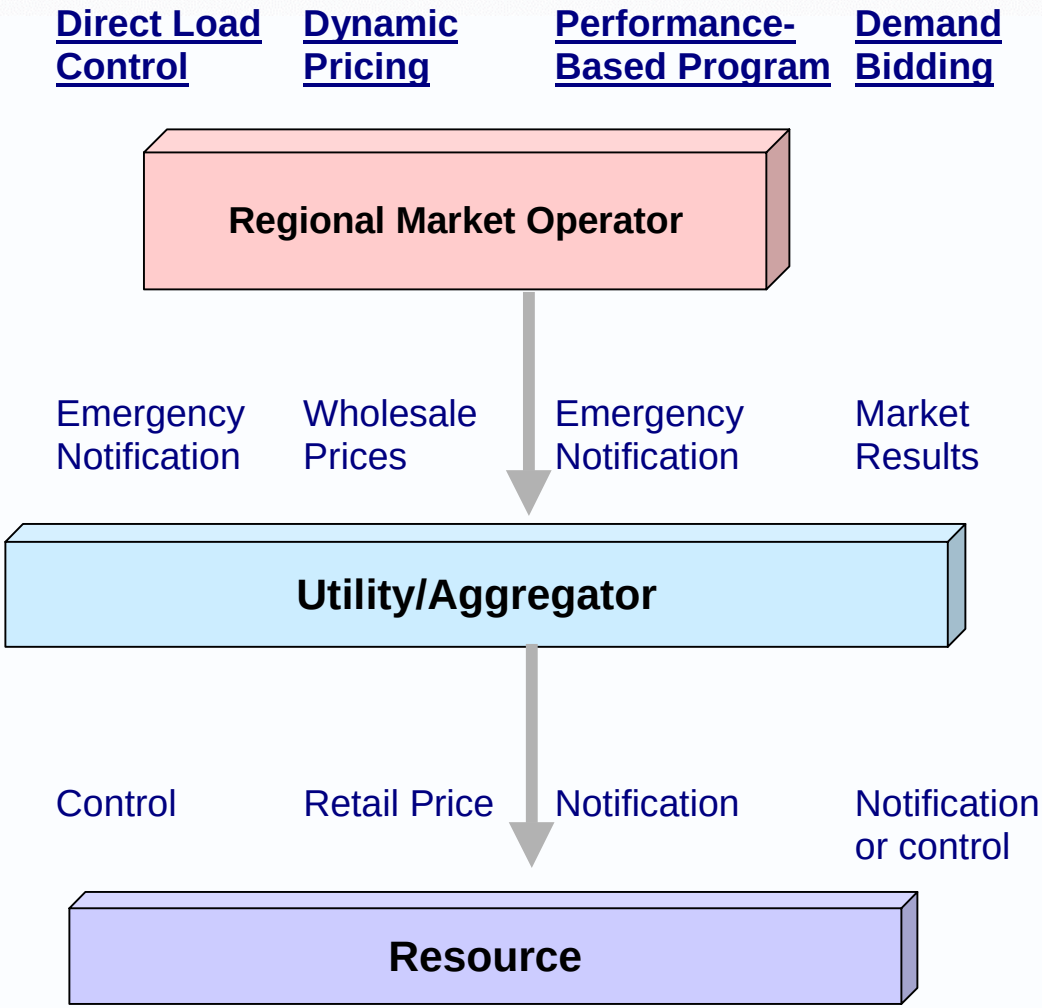
Bid, Receive Notifications, Update Resource Plan & Schedule, Deploy, Report Meter Data, and Perform Shadow Settlements

Demand Response Programs

Type of Program	Incentive Structure	Actuation by
RTO Emergency Program	Paid for Performance (at Fixed Price plus Capacity Reservation Fee)	Customer
RTO Economic Program	Paid for Performance (at Fixed Price or Market-based Price)	Customer
Demand-Side Bidding	Paid for Performance (at Market Price)	Customer
Utility Interruptible	Pay Discounted Rate	Utility or Customer
Dynamic Pricing	Pay time-varying Rate	Customer
Optional Binding Mandatory Curtailment	Better Served for Performance	Customer
Rolling Blackout	Equally Pay, Equally Served	Utility
Priority-wise Load Shed?	Pay to be Better Served	Utility

Various ways to incentivize demand to respond exist

Communications Down to DER



The Structure of Programs/Markets that DER will participate in Impact Communication and Control Requirements for DER

Capturing Value of DER Services

- Ancillary Services
  - CAISO ASPLP, ERCOT Load as a Resource, CPA DRP
- Supplemental or Other Energy
  - CAISO Aggregated DG Pilot Program
  - NYISO Day-ahead Economic Program
- Congestion Management
- Distribution System Support
  - DER for Utility Deferral of Distribution System Upgrades
- Blackout Mitigation
  - SDG&E Rolling Blackout Reduction Program
  - California Utility OBMC Program

Various DER Services of Value to the Grid -
Not Fully Captured Yet through Wholesale & Retail Tariffs

Summary

- SMD Implications on Communication & Control
  - RTOs must be able to rely on & verify contribution of DER
  - Systems must be in place to Support Demand-side Bidding
- Regional Markets & Retail Tariffs Incompass Business Opportunities for DER
- Market/Program Rules Impact
  - Incentives for DER Participants
  - Business Processes to participate
  - Communication & Control System Requirements
- Regional Electricity Market Rules Drive Communication & Control Systems for DER

Strategic Thinking for DER Includes Market Considerations

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